REMARKS

The applicant appreciates the Examiner's thorough examination of the application and requests reexamination and reconsideration of the application in view of the following remarks.

As a preliminary matter, the applicant respectfully submits that the Examiner's final rejection is premature because in response to the previous Office Action, the applicant did not amend to add new elements, but simply incorporated the "clamp-on" transducer element of dependent claims 12 and 15 into the independent claims.

Accordingly, the applicant requests that the Examiner withdraw the finality of the December 4, 2003 Office Action.

The Examiner rejects claims 1, 3-4, 8-10, 13 and 16-17 under 35 U.S.C. §103(a) as being unpatentable over U.S. Pat. No. 4,598,593 to *Sheen et al.* in view of U.S. Pat. No. 4,003,256 to *Donelan et al.* and further in view of U.S. Pat. No. 4,103,551 to *Lynnworth.* However, *Sheen et al.* does not disclose, teach or suggest the elements of the applicants' claimed invention, and the *Sheen et al.*, *Donelan et al.* and *Lynnworth '551* references, *inter alia*, teach away from one another and are not properly combinable. The cited references, even in combination, do not teach the applicant's claimed invention.

The applicant notes that even if an individual reference is cited in combination with other references, it is not a proper reference if it does not teach the element attributed to it. *Sheen et al.* does not disclose tag-modulated output signals. Claims are properly construed by referring to the specification and construing the terms of the claims as those terms would be construed by one of ordinary skill in the art. The applicant's invention is an anti-parallel tag flow measurement system, and the applicant claims tag-modulated output signals from the first and second transmitter receiver pairs. The applicant's independent system claims 1 and 8, as well as the independent method claim 13, each include, *inter alia*, the element of tag-modulated output and/or signals.

As understood by those of ordinary skill in the art, tag modulation is where inhomogeneities, turbulence, or matter such as bubbles, droplets or particles that are moving in the fluid flow are the "tags" that modulate the ultrasonic signals. The ultrasonic signals launched across the fluid are received by receivers after being modulated by the fluid flow. See, e.g., the applicants' specification at page 1, lines 8-15. High levels of noise or cross-talk substantially degrade the signal to noise ratio, making effective correlation of two received tag-modulated signals difficult or impossible. See, e.g., the applicants' specification at page 2, lines 3-8. Thus, as known by those of ordinary skill in the art, tag flow measurement includes tags in fluid flow that modulate ultrasonic signals, and noise is a disadvantage. Increasing the signal to noise ratio is desirable and accomplished by the applicant's claimed invention. See, e.g., the specification at page 11, lines 18-22.

In sharp contrast to the applicant's claimed tag-modulated output signals, *Sheen et al.* does not teach tag modulation as claimed by the applicant and as known to those of ordinary skill in the art. *Sheen et al.* does not teach ultrasonic signals modulated by tags in the fluid flow, and the disadvantage of noise. Quite the opposite, *Sheen et al.* teaches that an acoustic signal is applied to the pipe wall, and particles in the pipe striking the pipe create a noise signal, and the applied acoustic signal in the pipe wall is modulated by the noise signal produced by particle impingement. See, for example, *Sheen et al.* at column 2, lines 5-27.

Additionally, one of the advantageous results of the applicant's claimed anti-parallel tag flow measurement is reduction of cross-talk. See, e.g., the specification at page 6, lines 9-10. In sharp contrast, to reduce cross-talk between the receivers, *Sheen et al.* teaches an acoustic decoupler 12 literally separating the pipe into two sections. See, e.g., column 2, lines 23-26 and 66-68.

In summary, it is clear that *Sheen et al.* teaches away from tag modulation.

Therefore, the applicants request that the Examiner withdraw the rejection based on *Sheen et al.*[*], and based on *Sheen et al.* in combination with secondary and tertiary references.

Additionally, the law is clear that:

> Most if not all inventions arise from a combination of old elements ... Thus, every element of a claimed invention may often be found in the prior art ... However, identification in the prior art of each individual part claimed is insufficient to defeat patentability of the whole claimed invention. Rather, to establish obviousness based on a combination of the elements disclosed in the prior art, there must be some teaching of the desirability of making the specific combination that was made by the applicant. (With citations omitted and emphasis added.)

See In re Kotzab, 217 F.3d 1365, 1369, 55 USPQ 2d 1313, 1316 (Fed. Cir. 2000).

The Examiner asserts that *Sheen et al.* fails to teach the second transmitter receiver pair being mounted so that the ultrasonic paths of both pairs are anti-parallel chordal paths, but that *Donelan et al.* teaches anti-parallel paths. However, *Sheen et al.* and *Donelan et al.* teach away from each other and are not properly combinable. The structures and functions of *Sheen et al.* and *Donelan et al.* are fundamentally different.

First, *Sheen et al.* teaches transmitting and receiving transducers on a pipe, the transmitting and receiving transducers located on opposite sides of the pipe, for transmitting signals into the pipe. In contrast, *Donelan et al.* teaches positioning transducers in the fluid, with the acoustic energy travelling upstream and downstream in the pipe between respective transmitters and receivers. See *Donelan et al.* column 2, lines 64-68 and column 4, lines 19-25. Second, *Sheen et al.* teaches applying an acoustic signal to the pipe wall, modulating the signal with noise created by particles in the pipe, and cross-correlating the noise signals. In contrast, *Donelan et al.* teaches fluid motion is determined by computing the difference frequency between the acoustic path in the

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[*] In the specification the applicant mentions a clamp-on tag measurement system, namely, U.S. Patent Application Ser. No. 09/417,946 (now U.S. Pat. No. 6,293,156 by Shen et al.). However, as noted in the specification, U.S. Pat. No. 6,293,156 is commonly-owned with this patent application (and as noted in a response in this application, is not a reference under 35 U.S.C. 103).

direction of fluid flow and in the direction against fluid flow. See *Donelan et al.* column 2, lines 13-15. *Donelan et al.*'s analysis and control circuits 17 and19 in Figs. 1 and 2 of *Donelan et al.* "basically determine the difference or beat frequency between the resonant frequencies of the acoustic energy propagation upstream in the direction of fluid motion and downstream in the direction opposite to fluid motion". *Donelan et al.* column 4, lines 19-24. Third, *Sheen et al.* teaches that the respective transmitter and receiver pairs must be separated by an acoustic decoupler that literally separates the pipe into two sections, with one transmitter receiver pair on each section. In contrast, *Donelan et al.* teaches that the two ultrasonic energy paths are necessarily as close as practical, and further teaches that the device may have a single periodically reversing acoustic path. See, e.g., See, e.g., Fig. 1 and column 3, lines 11-14. Fourth, to reduce cross-talk between the receivers, *Sheen et al.* teaches the acoustic decoupler. In contrast, *Donelan et al.* does not teach the effects of cross-talk at all, because the transmitters and receivers are not on the pipe, but in the fluid.

The law is further clear that the teaching of the desirability of combining the references must not come from the applicant's invention. "There must be a reason or suggestion in the art for selecting the procedure used, other than the knowledge learned from the applicants' disclosure." See In re Dow Chemical Company, 837 F. 2d 469,473, 5 U.S.P.Q.2d 1529, 1532 (Fed. Cir. 1989) (with emphasis added). Additionally, an Examiner can satisfy the burden of showing obviousness of the combination only by showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references. In re Sang Su Lee, 277 F.3d 1338, 61 USPQ 2d 1430, 1433-44 (Fed. Cir. 2002).

The Examiner states as part of the rejection of claim 1 that this combination of references would increase the flow metering device's measuring sensitivity and make the device

more reliable and accurate. However, the applicant submits that these reasons do not overcome the antithetical nature of these two references and does not satisfy the requirement that there be some motivation, suggestion or teaching in the references of the desirability of making the specific combination, supported by some objective evidence of record.

> A critical step in analyzing the patentability of claims pursuant to section 103(a) is casting the mind back to the time of the invention, to consider the thinking of one of ordinary skill in the art, guided only by the prior art references and the then-accepted wisdom in the field ... Close adherence to this methodology is especially important in cases where the very ease with which the invention can be understood may prompt one to fall victim to the insidious effect of a hindsight syndrome wherein that which only the invention taught is used against its teacher.

See In re Kotzab, 217 F. 3d 1365, 1369, 55 USPQ2d 1313, 1316 (Fed.Cir. 2000) with citations and quotations omitted.

In summary, the cited references *Sheen et al.* and *Donelan et al.* do not teach the applicant's claimed invention and are not properly combinable.

Like the primary reference *Sheen et al.* and the secondary reference *Donelan et al.*, the tertiary cited reference *Lynnworth '551* also does not disclose, teach or suggest tag-modulated output signals, in contrast to the applicant's claimed invention. Moreover, *Lynnworth '551* is not properly combinable with either *Sheen et al.* or *Donelan et al.*

The applicant recognizes that the Examiner cites *Lynnworth '551* for the teaching of clamp-on transducers. However, the applicant's claimed invention, useful with clamp-on transducers and arising in the context of clamp-on transducers, solves disadvantages associated with clamp-on transducers, and the applicant's claimed combination of elements is not obvious. Additionally, the applicant discusses below particular reasons why *Lynnworth '551* is not combinable with *Sheen et al.* or *Donelan et al.*

Sheen et al. teaches the use and necessity of a structure configured to define two ultrasonic paths: one from the first transmitter to the first receiver; the other from the second transmitter to

the second receiver. *Sheen et al.* teaches applying acoustic signals to the pipe wall, modulating the signals with noise created by particles in the pipe, and cross-correlating the noise signals to ultimately measure particle velocity. In contrast, *Lynnworth '551* teaches a single path between a transmitter and a receiver, where the path is a particular chordal path, namely, a midradius chord. The path may consist of sequential path segments, each being an oblique midradius chord, but *Lynnworth '551* discusses the disadvantages of multiple chords from multiple transducers (including the requirement of numerous ports and resultant risk of leak in a pipe section), and thus teaches away from such a system. See column 2, lines 34-56. *Sheen et al.* does not measure transit times with and against the flow. In contrast, *Lynnworth '551* teaches that by transmitting simultaneously or alternately in both directions along the midradius chord, and measuring transit time intervals or quantities related thereto, line-integrated flow velocity is determined, which is the average velocity.** See, e.g., *Lynnworth '551* column 3, lines 19-22, column 4, lines 4-10, and column 10, lines 31-35.

It is clear that the structures and functions of *Sheen et al.* and *Lynnworth '551* are fundamentally different, as would be apparent to one of ordinary skill in the art.

With respect to *Donelan et al.*, *Donelan et al.* teaches transmission of ultrasonic energy in the direction of fluid motion and against the fluid motion on parallel paths. See, e.g., Fig. 1 of *Donelan et al.* In contrast, *Lynnworth '551* teaches transmission of ultrasonic energy with and against fluid flow but in chordal paths, particularly, special midradius chordal paths. See, e.g., Figs. 5A, 7A, 9A, 11 of *Lynnworth '551*. The choice of paths is not trivial or interchangeable. In *Donelan et al.*, the upstream and downstream paths are chosen so that fluid motion is determined by computing the difference in frequency between the acoustic path in the direction of fluid flow and in the direction against fluid flow. *Donelan et al.* column 2, lines 13-15. In *Lynnworth '551*,

** This is based on the discovery in *Lynnworth '551* that the measured value of flow velocity will be an accurate measure of average flow velocity, because at the midradius chord the meter factor K=1. Since K=average

the midradius chordal paths are chosen to achieve a meter factor K=1 thereby eliminating the need to determine Reynolds number Re, which in turn eliminates the need to determine factors that influence Re, i.e. density ρ and viscosity η. In this way, when transit time intervals or quantities related to are measured to determine V_c, average velocity is obtained without the necessity of determining a host of other parameters. The structure and function of *Donelan et al.* and *Lynnworth '551* are fundamentally different.

In other words, to change the paths of either *Donelan et al.* or *Lynnworth '551* would be to render them ineffectual. Accordingly, these cited references are not properly combinable.

In summary, *Lynnworth et al.* is not properly combinable with either the primary reference *Sheen et al.* or the secondary reference *Donelan et al.*, and *Donelan et al.* is not properly combinable with *Sheen et al.*

Also, the Examiner states as part of the rejection of claims 8 and 13 that the combination of references would increase the flow metering device's measuring sensitivity, make the device more reliable and accurate, and make the device simple, reliable and highly sensible. However, the applicant submits that these reasons do not overcome the antithetical nature of these references and do not satisfy the requirement that there be some motivation, suggestion or teaching in the references of the desirability of making the specific combination, supported by some objective evidence of record.

Accordingly, independent claims 1, 8 and 13 are not obvious over *Sheen et al.*, *Donelan et al.*, *Lynnworth '551* nor their combination, and thus claims 1, 8 and 13 are in condition for allowance. Claims 2-7 and 16-17 depend directly or indirectly from claim 1; claims 9-11 depend directly or indirectly from claim 8; and claim 14 depends directly or indirectly from claim 13; and thus these claims are also in condition for allowance.

The Examiner also rejects claims 2, 5-6, 11 and 14 under 35 U.S.C. 103(a) as being

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velocity/integrated line velocity, when integrated line velocity is determined, average velocity is determined.

unpatentable over *Sheen et al.* in view of *Donelan et al.* and *Lynnworth '551*, and further in view of U.S. Pat. No. 4,528,857 to *Bruner*. The Examiner further rejects claim 7 as being unpatentable over the combination of *Sheen et al.*, *Donelan et al.*, *Lynnworth '551* and U.S. Pat. No. 5,503,035 to *Itoh et al.*

The Examiner avers that with respect to claims 2, 5, 6 and 14 that it would have been obvious to one of ordinary skill in the art to modify the flow metering device of *Sheen et al.* by utilizing different frequencies of operation in both transmitters, or utilizing demodulation, as taught by *Bruner*, to prevent cross-talk and therefore increase the reliability of a flow-metering device.

However, one skilled in the art would not be motivated to combine *Sheen et al.* and *Bruner*. Assuming *arguendo* that *Bruner* teaches prevention of cross-talk by utilizing different frequencies, the system of *Sheen et al.* eliminates cross-talk by inserting a decoupler between the pairs of transducers. There would be no motivation to one skilled in the art to incorporate *Bruner* to modify *Sheen et al.* to eliminate cross-talk when *Sheen et al.* has already eliminated cross-talk.

Additionally, *Bruner* teaches that for its phase modulation system, it is important that the transducer pairs each have the receiver located essentially diametrically opposite the transmitter. See *Bruner* column 3, lines 46-48. In contrast, *Lynnworth '551* teaches that to measure transit time and related factors to determine average velocity, the transducers must be positioned between midradius chordal paths. In summary, the structure and function taught by *Lynnworth et al.* and *Bruner* are diverse and not properly combinable.

With respect to the rejection of claim 7 and the *Itoh et al.* reference regarding continuous waves, claim 7 depends from claim 1 and is allowable for that reason.

Moreover, *Itoh et al.* teaches continuous waves in the context of a vortex type flow

meter with a vortex generator. As is known in the art, this type of flowmeter utilizes an intrusive bluff body to create, under conditions of steady turbulent flow in the device's linear range, equidistant and relatively strong reproducible vortices. These vortices are not randomly spaced, and are strong enough to be visible in wind tunnel experiments with the aid of standard smoke techniques. The electronics for detecting such regularly shed vortices are therefore suitable for their intended purpose. Applying any portion of such techniques to detecting random effects of turbulence, whose eddies differ from moment to moment, is quite another matter. The problems are as different as a periodic Karman vortex street pattern is from random turbulence patterns.

Itoh et al. further teaches only one transmitter and one receiver facing each other at right angles to the flow direction, to count the number of vortices passing through the ultrasonic signal propagation path per unit time, and the use of deep grooves in the pipe near the transmitter and receiver to reduce noise. See, e.g., column 1, lines 27-46, column 2, lines 6-11, and column 10 lines 15-23. *Itoh et al.*'s teaching of a single path and orientation, means for reducing noise, as well as the contrasting methodology that would be understood by one of ordinary skill in the art, are in contrast to the other cited references and the applicant's claimed invention. It is clear that *Itoh et al.* is not properly combinable, and also fails to teach the applicant's claimed invention.

The applicant re-iterates that identification in the prior art of each individual part claimed is insufficient to defeat patentability of the whole claimed invention. Rather, to establish obviousness based on a combination of the elements disclosed in the prior art, there must be some teaching of the desirability of making the specific combination that was made by the applicant. See In re Kotzab, *supra*. Also, there must be a reason or suggestion in the art for selecting the procedure used, other than the knowledge learned from the applicant's disclosure.

See In re Dow Chemical Company, *supra*.

The cited references do not contain all of the applicant's claimed elements, and there is no teaching of the desirability of making the specific combination that was made by the applicant.

In addition, claims 2, 5-6, 11 and 14 depend directly or indirectly from either independent claim 1, 8 or 13, and are thus allowable for the additional reasons as set forth herein.

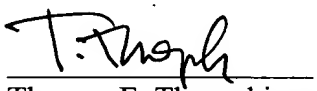
CONCLUSION

Each of the Examiner's rejections has been addressed or traversed. Also, the applicants incorporate herein by reference the arguments included in the previous responses because not all of those arguments are necessarily moot in light of the Examiner's current rejections.

Accordingly, it is respectfully submitted that claims 1-11, 13-14 and 16-17 are in condition for allowance. Early and favorable action is respectfully requested.

If for any reason this Response is found to be incomplete, or if at any time it appears that a telephone conference with counsel would help advance prosecution, please telephone the undersigned or his associates, collect in Waltham, Massachusetts at (781) 890-5678.

Respectfully submitted,



Thomas E. Thompkins, Jr.
Reg. No. 47,136